

TAXONOMIC IDENTITY OF "HALLUCINOGENIC" HARVESTER ANT (*Pogonomyrmex californicus*) CONFIRMED

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ABSTRACT.—The use of California harvester ants (*Pogonomyrmex californicus*) for visionary and therapeutic ends was an important but poorly-documented tradition in native south-central California. In this brief report, a confirmation of the taxonomic identity of the red ant species used in California is presented, and the descriptive record of its use is supplemented with additional ethnographic accounts. This taxonomic identification of this species is of particular importance, as visionary red ant ingestion provides the only well-documented case of the widespread use of an insect as an hallucinogenic agent.

RESUMEN.—La utilización de hormigas granívoras rojas (*Pogonomyrmex californicus*) con fines alucinógenos y terapéuticos, fue una tradición de mucha importancia pero mal documentada en el sur y centro-sur de California. Este breve artículo confirma la identidad taxonómica de dicha especie y la descripción de su uso se hace a través de datos etnográficos adicionales. Esta identificación taxonómica es de especial interés, puesto que es el único ejemplo etnográfico debidamente documentado de un agente alucinógeno derivado de un insecto.

RÉSUMÉ.—L'utilisation des fourmis moissonneuses rouges (*Pogonomyrmex californicus*) à des desseins religieux et thérapeutiques était une tradition peu documentée mais importante dans la vie de plusieurs groupes autochtones du centre-sud de la Californie. Dans ce bref exposé on trouve la confirmation de l'identification taxonomique de la fourmi et à la description de la méthode de son utilisation s'ajoute des données ethnographiques supplémentaires. L'intérêt de ce sujet est considérable car il s'agit là du premier exemple ethnographique bien documenté d'un agent hallucinatoire que provient d'un insecte.

INTRODUCTION

This report supplements an article previously published in this journal under the title, "Ritual and Therapeutic Use of 'Hallucinogenic' Harvester Ants (*Pogonomyrmex*) in Native South-Central California" (Groark 1996). In this earlier paper, I presented an overview of a widespread, but poorly documented, tradition of visionary and curative red ant ingestion among native southern Californian Indians. Building on several key ethnohistoric accounts from the unpublished field-notes of Smithsonian ethnologist and linguist John P. Harrington (as well as a number of obscure published sources), I reconstructed the general details of this "ant ingestion tradition," outlining its cultural distribution and probable origins. The paper closed with a discussion of ant venom bioactivity and toxicology, as

well as preliminary suggestions concerning likely biochemical bases for the psychoactive effects reported in the ethnographic record.

Recently, another early account written by J.P. Harrington has come to my attention. In addition to supplementing our understanding of ritual ant use with additional ethnographic details from the Luiseño-Juaneño Indians, Harrington also provides us with a precise taxonomic identity for the red ant species used in native southern California. This "new" account is particularly significant in its confirmation of the speculative taxonomic identification offered in Groark (1996). In addition, a set of *Pogonomyrmex* specimens collected by Harrington has been located in the ant collection of the Smithsonian Institution, further increasing the certainty of the identification.

In the present report, I provide a brief summary of the major features and distribution of ritual and therapeutic red ant use, followed by a presentation and discussion of the aforementioned Harrington account (which is currently accessible only in a very rare edition), as well as a description of the newly located specimens. The paper closes with a discussion of the significance of this taxonomic confirmation for future toxicological studies of *Pogonomyrmex* species and their utilization in visionary contexts. This identification is of particular importance, as it provides the only well-documented case of the widespread use of an insect as an hallucinogenic agent.

OVERVIEW OF CULTURAL DISTRIBUTION

Visionary Use of Red Ants.—Ingestion of red ants for visionary and shamanic ends was most highly developed among the indigenous groups of south-central California, seven of which are known to have engaged in the practice. The ants were swallowed alive and unmasticated, in massive quantities (often exceeding 400 ants), in order to induce a prolonged state of unconsciousness during which tutelary spirits (usually referred to as "dream helpers" or "**suertes**") appeared to the aspirant, often becoming life-long supernatural allies. These visions, which often took the form of animals or personified natural forces, were highly sought after by young men—quite apart from any specific skills they might confer, dream helpers (and the power they embodied) were critically important in leading a safe, healthy, and prosperous life. In addition, men who aspired to be shamans would ingest repeatedly red ants or the potently hallucinogenic **toloache** (more commonly known as Jimsonweed; *Datura wrightii* Regel) over a period of months or years. If they were fortunate, they gradually acquired multiple or specialized dream helpers who bestowed extraordinary shamanic skills upon them. (See Groark [1996: 7–11] for detailed accounts of the ritual administration and resulting visions.)

The ingestion of red ants in visionary contexts appears to have been strongest among the Shoshonean groups occupying the southeastern edge of the south-central region of California—the Kitanemuk (Harrington 1986b:rl.98, frs.449–450), Kawaiisu (Zigmond 1977:62, 1986:405), Tübatulabal (Voegelin 1938:5, 46, 67–68), and the various Hokan-speaking Chumash groups, particularly the Interior Chumash (Harrington 1986b:rl.98, frs.608–609, 648–652). In the Central Valley to the north, some of the neighboring Southern Valley Yokuts (particularly the Yawel-

mani) and Southern and Central Foothill Yokuts (Wikchamni, Yawdanchi, Bokninwad, Yokod, and Palewyami) also swallowed ants in order to gain dream helpers and shamanic power (Harrington 1986a:rl.94, fr.387; Driver 1937:99), but the practice among these latter groups appears in a somewhat attenuated form. The Northern Miwok are also reported to have ingested ants "for vision or power" (Aginsky 1943:440).

Collectively, these groups constitute the core of the visionary ant ingestion tradition. Based on the reported distribution, the practice appears to have developed among the Shoshonean-speaking groups of the southern Sierra Nevada region, spreading to the Interior Chumash to the west, then on to the various Yokutsan groups occupying the southern end of the San Joaquin Valley. Interestingly, this distribution is largely coextensive with the Toloache-Dream Helper complex, an egalitarian religion stressing individual contact with the supernatural and the acquisition of one or more dream helpers (usually mediated through the ingestion of *Datura wrightii* Regel).

Boys' Ant Ordeal.—A number of groups in southern California also administered the ants externally (and on occasion, internally as well) in the "ant ordeals" of the boys' initiation ceremonies. These ordeals were ubiquitous among the Takic-speaking Cupan groups in southern California (Gabrielino-Fernandeño, Luiseño-Juaneño, Cahuilla, Cupeño), especially those involved in the proto-historic Chingichngish religion.¹ It should be emphasized, however, that these "ordeals" lacked the visionary component that formed such an important part of ritual ant use as reported from the south-central groups.

In 1852, Hugo Reid described the ant ordeal of the Gabrielino as follows:

To make them hardy and endure pain without wincing (for cowardice as to corporeal suffering was considered even among the women as disgraceful) they would lie down on the hill of the large red ant, having handfuls of them placed in the region of the stomach and about the eyes. Lastly, to ensure a full dose, they swallowed them in large quantities, alive! [Reid 1968 (1852): 36].

In a revealing comment, one of Harrington's Kitanemuk informants identified these ants as being identical to the vision-inducing red ants used by the south-central groups described above (Harrington 1986a:rl.98, fr.443).

A number of ethnographic accounts indicate that similar ant ordeals were found further to the north among the Chumash (Hudson 1979:73), the Tübatulabal (Driver 1937:98), the Northern Miwok (Aginsky 1943:440), and possibly the Monache (Driver 1937:99). Among these groups, the ordeal often lacked the formal initiatory function found among the groups that were integrated into the Chingichngish religion. Instead, the practice served to mark the transition from youth to adulthood.

It is interesting to note that, although visions are not reported to have manifested, loss of consciousness was common during these ordeals and appears to have been an explicit goal. Profound loss of consciousness was considered essential to shamanic, visionary, and initiatory practice throughout the region, and was understood to represent a sort of "small death" in which the aspirant was

"killed" by the supernatural agents which he wished to contact. Despite the lack of associated visions, the goal of the ant ordeal was largely identical to that of visionary ant ingestion—augmentation of individual strength and fortitude, and the establishment of a personal connection with supernatural power. Both visionary ingestion and the ant ordeal of boys' initiation ceremonies represent the individual's first personal contact with supernatural power—a connection which he could then draw on in daily life for vigorous health, luck in hunting or gambling, or for more esoteric purposes (see Groark [1996: 9–10, 16–17] for additional details).

Therapeutic Uses.—In addition to the esoteric uses outlined above, the ants played an important role in both curative and preventative medicine, treating a diverse inventory of common ailments, including: paralysis, gastrointestinal ailments, severe colds, pain, arthritis, and gynecological disorders (particularly those occasioned by childbirth). Ethnohistoric accounts indicate that initiatory and therapeutic ant ingestion persisted through the Mission Period (in some cases, surviving until at least the mid-1850's), but these practices appear to have been abandoned by the turn of the century (see Groark 1996: 11–16 for a detailed discussion).

A NOTE ON INDIGENOUS NOMENCLATURE

A brief survey of indigenous nomenclature reveals striking homogeneity in the name applied to this ant among Takic-speakers of both the Serran and Cupan branches. The ant used in these ceremonies was referred to by the Kitanemuk as 'anəqt or 'anəht (pl. anəm). Zigmond records the Kawaiisu name as **aanat** ("big red ant—eat for pain") (Unpublished 1937 fieldnotes of M.L. Zigmond; quoted in Anderton 1988:270), while the Luiseño-Juaneño term was **anut** ("red ant") (Kroeber 1925:672). It should be noted that this name was not a generic term for "red ant". Rather, it applied specifically to the "medicinal red ant" used in ritual and therapeutic contexts, with other local species being referred to by distinct names (see Anderton 1988: 597; Harrington 1933:164, note 128).

Neighboring non-Takic groups had very different names for this ant—the Chumashan groups appear to have used the term **shutilhil** (Walker and Hudson 1993), while various Yokutsan speakers of the Tule-Kaweah dialects (Yawdanchi, Wikchamni, Gawia, Bokninwad, Yokod), referred to these ants as **k'awk'aw**, "crazy ants," possibly in reference to their intoxicating potential (Harrington 1986a: rl.94, fr.382).

WAS *POGONOMYRMEX* THE SPECIES USED IN CALIFORNIA?

Despite the surprising detail and high quality of many of the sources cited above, these early accounts provide neither the common nor scientific name for the ant species in question. As a result, I was forced to assume a somewhat speculative tone in the previously published article (Groark 1996). Based on an analysis of the biological and behavioral details provided in the ethnographic literature, I concluded that the ant was most likely a *Pogonomyrmex* species, but acknowledged the problems inherent in any precise identification:

The taxonomic status of the red ant species used in aboriginal California is uncertain. All ethnographic accounts describe them merely as "large red ants". . . . The accounts uniformly emphasize their large size, the fact that they build small mounded nests, and the excruciating pain of their sting. . . . Unfortunately, no voucher specimens were collected when the ethnographic accounts were recorded, and the precise taxonomic identity of the ant species must therefore remain tentative. However, the taxonomic and toxicological literature strongly support the assertion that a *Pogonomyrmex* species was indeed the red ant referred to in the ethnographic accounts. Of all the ant genera present in California and the Great Basin, *Pogonomyrmex* is distinguished by the large size, exceptionally painful sting, and highly biodynamic venom of its representative species. [Groark 1996:3]

Based on the ecological distribution of the various *Pogonomyrmex* species present in California, it seemed probable that the most common and conspicuous species, *P. californicus*, was the ant referred to in the accounts. Based on this inference, I proceeded to examine the ethnographic accounts in light of general biology and toxicology in order to assess possible pharmacological underpinnings for the reported visionary and therapeutic effects.

While the results were far from conclusive, a survey of the toxicological literature indicated that the *Pogonomyrmex* species present in California possess potentially toxic venom containing a number of highly bioactive compounds, including: kinins, peptides, and neurotoxins, as well as complex alkaloids previously known only from certain higher plant taxa. In large quantities, these venom constituents are capable of acting on the mammalian central nervous system, triggering a wide range of psychophysiological reactions that includes highly altered metabolic states resembling those reported ethnographically.

In addition, Harvester ants of the genus *Pogonomyrmex* have been shown to possess the most toxic insect venom recorded to date. Their venom has the highest known mammalian lethality of any arthropod—it is 5 times more toxic than the venom of the Oriental hornet, and 8 to 10 times more toxic than honeybee venom (Schmidt and Blum 1978a,b,c). Based on unpublished venom lethality data for *P. californicus* provided to me by Justin Schmidt, I determined that the doses employed in visionary contexts by California Indians were clearly within the range of pharmacological activity, representing approximately 35% of a lethal dose for an individual with a body weight of 100 lb. (45.5 kg). (See Groark [1996: 17–22] for a full discussion of venom toxicology and complete LD₅₀ calculations).

Despite these compelling data, my argument was weakened by the uncertainty of the taxonomic identity of the ant. I was therefore extremely pleased to come across a key reference which resolved this ambiguity—a footnote written by John P. Harrington in his 1933 annotation of the *Relación Histórica*, Fray Gerónimo Boscana's classic Mission Period account of the Luiseño-Juaneño Indians of Southern California.

In this extensive note, Harrington clearly identifies the ant species in question as *Pogonomyrmex californicus* Buckley, and provides additional ethnographic details based on his own field research with surviving Luiseño-Juaneño individuals (the

bulk of which was carried out intermittently between 1919 and 1933). Due to the rarity of these accounts, I will reproduce two variant versions of Boscana's original text as well as Harrington's annotation in full.

The "New" Accounts: Two Versions and an Annotation.—The author of these accounts, Gerónimo Boscana, was a Franciscan friar who lived among the predominantly Luiseño-Juaneño amalgamation of Indians at Mission San Juan Capistrano from May 1814 to January 1826. While there, he assiduously recorded all details of life in the pre-mission period with the help of three Luiseño-Juaneño men—two of whom were local chiefs, and the other a shaman. The resulting account, properly known as the *Relación Histórica*, was probably first compiled around 1822, and remains one of the earliest and most detailed descriptions of aboriginal life in native southern California.²

In several brief passages Boscana mentions the therapeutic use of large red ants by the local Indians when they were still "in their heathen state." The ants were applied externally in the treatment of unspecified "pains":

... the most frequent and commonest practice, especially when in pain, was to whip the place where the pain was with nettles, and to put them right on the place of the pain, and likewise ants, and these latter especially on sores, and in this manner they cured themselves. [Harrington 1934: 49]³

Boscana's most extensive description relates to the "ant ordeal" that formed the conclusion of the boys' initiation ceremony into the Chingichngish religion of the Gabrielino, Luiseño, and Juaneño Indians. All boys were subjected to this ordeal, which was performed during early adolescence in order to "harden" the youths, to provide luck and skill in hunting, and to ensure a long life. Robinson's 1846 translation of the *Relación Histórica* describes it in the following terms:

The Indians were obliged to undergo still greater martyrdom to be called men, and to be admitted among the already initiated, for, after the ceremony of the **potense** [ritual initiatory branding with *Artemisia vulgaris* L.], they were whipped with nettles and covered with ants that they might become robust. This infliction was always performed in summer, during the months of July and August when the nettle was in its most fiery state. They gathered small bunches which they fastened together and the poor deluded Indian was chastised by inflicting blows with them upon his naked limbs until he was unable to walk. He was then carried to the nest of the nearest and most furious species of ants, and laid down among them, while some of his friends, with sticks, kept annoying the insects to make them still more violent. What torments did they not undergo! What pain! What hellish inflictions! Yet their faith gave them power to endure all without a murmur, and they remained as if dead. Having undergone these dreadful ordeals, they were considered as invulnerable, and believed that the arrows of their enemies could no longer harm them. [Robinson 1846; reproduced and annotated in Harrington 1933: 47]

A slightly different account of this event is found in J.P. Harrington's translation of the "Cessac manuscript" of the *Relación*, which reads as follows:

After this sacrifice [the **potense** ceremony], having been well lashed with nettles, they placed the patient on a nest of fierce ants, and another one was stirring them up to make them still fiercer, and since the patient had no more clothes on than what he brought from the belly of his mother, we can imagine in what condition he must have been, after having been thoroughly lashed with nettles, as a result of those fierce ants, which even cause fever. And so great was their patience, that they seemed like dead, without a groan or movement. These were the ones called cured. There were some who suffered through this torture several times over, and many went through it alone or with some companion, for they believed that when thus cured, they were from that time on more agile, and that the arrows of their enemies could not harm them." [Harrington 1934: 19]

In his annotation to the first of these two passages, Harrington elaborates on Boscana's basic account, including observations derived from his own ethnographic research among the Luiseño and Juaneño Indians:

The ants used in the ant stinging of the boys' ceremony were [called] 'aanat, pl. 'antum, *Pogonomyrmex californicus* Buckley, California Harvesting Ant. This is a good-sized red ant, the medicinal ant of these people. It is plentiful throughout the region, making large nests in the ground, and is not much of a climber, being unable to climb out of a bottle. When irritated, it stings with its abdomen, injecting formic acid, and bites with its mandibles at the same time. The ant dies after a time, his carcass still clinging to the skin of the person stung if the attachment is successful. The sting is claimed by the Indians to be as painful as a European bee sting, and hurts noticeably for fifteen minutes or more.⁴ Doubtless when the Indians lay about the camps naked they were stung much more frequently than at present.

When these ants were used as medicine, to relieve rheumatism, internal pains, and the like, one method was to pick a number of the ants, one after another, and place them on the afflicted part, where they stung and were allowed to remain until they dropped off or got accidentally brushed off; Eustaquio [Lugo] once cured himself by putting a dozen or more of them on his bosom thus and leaving them on for hours. Another and evidently more modern method is to put a goodly number of the ants in a piece of cheesecloth and press it against the afflicted part, whereupon the ants sting through the cheesecloth. This cloth method is said to have been used in the boys' ceremony, but the earlier method was undoubtedly to seat and lay the named boy on a nest of these ants, or better to dig out the nest and seat and lay him in the teeming hole. There was not a part of the boy that was not stung and the ordeal was continued until the boy fainted or weakened, and all this without a murmur on the part of the boy. The ants were also administered as medicine given to sick people internally, being swallowed alive, but I have not found an informant who recalled that they were swallowed in the boys' ceremony ... [Harrington 1933:164, note 128]

Later in the note, Harrington indicates that the Luiseño-Juaneño referred to this ritual as 'antush (< 'aanat "red ant")—literally, "an anting" (Harrington 1933: 164, note 128)!

Although this account was published in 1933, Harrington's notes indicate that he had been collecting data on ritual and initiatory ant ingestion intermittently since at least 1910 among the Kitanemuk, Interior Chumash, and various Yokutsan groups. Unfortunately, the descriptions contained in his manuscript fieldnotes contain only indigenous names for the ants—no common name or Latin binomial was provided. The above account is therefore of great importance, as it provides us with the first proper taxonomic identification of the species involved.

Harrington's Identification: Inference or Scientific Determination?—Despite the excitement of finding Harrington's note confirming my earlier speculative identification, a nagging question remained: How did Harrington arrive at this identification? Was it merely an inference derived from a general familiarity with the southern California environment, or was it based on properly determined voucher specimens?

We know that Harrington was an obsessively meticulous fieldworker. In addition to collecting careful data on indigenous nomenclature and usage, he was also a conscientious collector of botanical and zoological specimens (most of which, unfortunately, have not survived in an identifiable state). In an interesting twist to this story, Dr. Ted Shultz—a myrmecologist at the Smithsonian Institution—discovered a set of Harrington's vouchers in the Smithsonian's ant collection after reading a draft version of this paper.

Stored just 15 feet from his office door, Dr. Schultz found a specimen set consisting of six pins holding four workers, one male, and one female. The specimens are collectively identified as "*Pogonomyrmex californicus* (Buck) sp. det Roh.", and each bears an identical label reading: "J.P. Harrington, Collector." According to Schultz, the identification label indicates that the species determination was made by Sievert Allen Rohwer, a hymenopterist who worked at the Smithsonian's National Museum of Natural History from 1909 to 1951. From 1925 to 1937, most ant identifications were referred to Rohwer, suggesting that Harrington deposited the specimens during this period.

Although the specimen labels indicate that the ants were collected in Cottonia, Arizona (and not southern California), their discovery—when considered along with their probable date of deposit—strongly suggests that Harrington's 1933 identification was indeed based on properly documented and determined voucher specimens (or at the very least, that his published identification derived from voucher specimens collected after his Luiseño-Juaneño fieldwork, but before his 1933 Boscana annotation).

CONCLUSIONS

The combination of three lines of evidence—the physical and ecological description of the species, Harrington's precise 1933 entomological identification, as well as the discovery of his *Pogonomyrmex* voucher specimens—allows us to make a strong argument that *Pogonomyrmex californicus* was, in fact, the ant species used

for visionary and medicinal purposes in native California. That such an identification can be confirmed more than a century after the species' last known use is eloquent testimony to the importance of voucher specimens in anthropological research, as well as to the importance of the collections that preserve such materials.

Despite the fact that our knowledge of red ant ingestion comes principally from a patchwork of early ethnohistoric accounts, these narratives—when considered in their entirety—provide us with a remarkably complete and well-attested ethnographic example of the use of an insect as an hallucinogenic agent. Although there have been scattered references to non-botanical hallucinogens, most prior claims have suffered from a lack of documentation—either inadequate ethnographic descriptions or a confusion surrounding the identity of the species in question.⁵ With the publication of this report, the taxonomic identity of the red ant used in native California has been confirmed, and the descriptive record of its use is supplemented with several additional ethnographic accounts. This new taxonomic certainty places future toxicological investigations on a much firmer footing, adding a key piece to our reconstruction of “hallucinogenic” harvester ant use in native south-central California.

NOTES

¹ The Chingichngish religion is classified as one of two major religious subsystems that developed out of the *Datura*-based toloache cult of southern California (Kroeber 1925; Blackburn 1974). The Chingichngish religion appears to have originated among the Gabrielino during the proto-historic period, then spread to neighboring groups, possibly through indigenous evangelization (Bean and Vane 1978). Its doctrine centered around mythic accounts of a shaman-like culture hero named Chingichngish who taught the people a new set of beliefs, which appear to have become integrated with older local traditions. Unlike the toloache cult—an egalitarian religion based on vision seeking and the acquisition of “dream helpers” through the ceremonial ingestion of *Datura wrightii*—the Chingichngish religion was characterized by esoteric doctrine, highly formalized rituals and initiations, and the construction of ceremonial enclosures into which only the initiates were admitted (hence the frequent reference to the Chingichngish “Cult”). For more detailed information, see Johnson (1962) on the Gabrielino, and Sparkman (1908), DuBois (1908), and White (1963) on the Luiseño.

² There were at least three versions of Boscana's original account, only one of which is known to have survived. Based on the surviving copy, the original title appears to have been “*Relación histórica de la creencia, usos, costumbres, y extravagancias de los indios de esta Misión de San Juan Capistrano llamado la nación Acagchemem.*” The first full published version of Boscana's account was Robinson's (1846) English translation, retitled “Chinigchinich” and published as an appendix to the first-edition of his book *Life in California*. (Robinson chose the title “Chinigchinich” because of the prominence of this mythical figure in Boscana's account, and it has since become the *de facto* name for this document.) His translation appears to have relied upon two slightly different original manuscripts, both of which have been lost (however, stylistic peculiarities suggest that the Cessac manuscript described below was one of the source versions). In 1933, J.P. Harrington republished Robinson's translation, supplementing it with 132 pages of ethnographic annotations (as a result, this edition is often referred to as “Harrington's Chinigchinich.”) Sometime during this period,

Harrington also succeeded in locating a "new lost original Boscana" manuscript in the Bibliothèque Nationale in Paris. This version—now known as the "Cessac Manuscript"—is written in Boscana's own hand, providing us with the only surviving original manuscript. This version, which differs in some details from Robinson's translation, was published in English by Harrington (1934) and in the original Spanish by Reichlen and Reichlen (1971). For the sake of clarity, I will refer to all versions of the text as Boscana's *Relación Histórica*, but I cite them under the surname of the translator or editor in order to distinguish between the numerous variant editions.

³ This practice appears to have been based on the principle of counter-irritation, and was widespread among southern and south-central Californian groups. Interestingly, the venom of the ant *Pseudomyrmex* has been shown to be an efficacious treatment for chronic rheumatoid arthritis (Schultz and Arnold 1978), and there is evidence that a component in honey-bee venom alleviates arthritic pain and associated symptoms (Dr. Roy Snelling, Los Angeles Museum of Natural History: personal communication 1995).

⁴ *Pogonomyrmex* stings are exceedingly painful and long-lasting, and have been described as approximating "ripping muscles or tendons" or "turning a screw in the flesh around the sting site"—and all of this accompanied by a nervous, chilling sensation that sweeps upward from the site of the sting (Schmidt 1986).

⁵ The only well-documented hallucinogen of non-botanical origin comes from the Sonoran Desert Toad (*Bufo alvarius* Girard), which accumulates prodigious quantities of 5-MeO-DMT in its venom glands (Weil and Davis 1994). A number of neotropical toads and frogs (mostly *Dendrobates*, *Phylllobates*, and *Phyllomedusa*) also secrete toxins which are used by the Amahuaca and Matsés Indians of the Peruvian Amazon in hunting magic, although visions are usually not reported (Carneiro 1970, Amato 1992). Interestingly, these intoxicating cutaneous alkaloids are not endogenously produced—rather, they are sequestered from dietary sources which include alkaloid-rich myrmicine ant species (Daly 1994). The only reference to an insect-based hallucinogen is an anecdotal report by Saint-Hilaire (1824) referring to a larval moth (*Myelobia smerintha* Huebner) used by the Malali Indians of Brazil to produce an opium-like, dream-filled sleep. While Britton (1984) has proposed that the gut or salivary glands of this larval moth be classified as a new hallucinogen, Ott (1993: 414) argues that, if confirmed, the moth is more accurately regarded as an "oneirogenic" or "dream-inducing" agent, and classifies all of these cases as "putative" hallucinogens.

LITERATURE CITED

- AGINSKY, BURT W. 1943. Culture Element Distributions: XXIV Central Sierra. University of California Anthropological Records 8:393–468.
- AMATO, I. 1992. From "Hunter Magic," a Pharmacopoeia? *Science* 258: 1306.
- ANDERTON, ALICE JEANNE. 1988. The Language of the Kitanemuks of California. Ph.D. Dissertation, University of California, Los Angeles.
- BEAN, LOWELL JOHN and SYLVIA BRAKKE VANE. 1978. Cults and their Transformations. Pp. 662–672 in *Handbook of North American Indians*, Vol. 8—California (Robert F. Heizer, ed.). Smithsonian Institution, Washington, D.C.
- BLACKBURN, THOMAS C. 1974. Ceremonial Integration and Social Interaction in Aboriginal California. Pp. 93–110 in *'Antap: California Indian Political and Economic Organization* (Lowell J. Bean and Thomas F. King, eds.). Balena Press: Ramona California.
- BRITTON, E. B. 1984. A Pointer to a New Hallucinogen of Insect Origin. *Journal of Ethnopharmacology* 12:331–333.
- CARNEIRO, ROBERT L. 1970. Hunting and Hunting Magic Among the Amahuaca. *Ethnology* 9:331–341.

- DALY, JOHN W. 1994. Dietary Source for Skin Alkaloids of Poison Frogs (Dendrobatidae). *Journal of Chemical Ecology* 20:943-955.
- DRIVER, HAROLD E. 1937. Culture Element Distributions: VI Southern Sierra Nevada. *University of California Anthropological Records* 1:53-154.
- DU BOIS, CONSTANCE (GODDARD). 1908. The Religion of the Luiseño and Diegueño Indians of Southern California. *University of California Publications in American Archaeology and Ethnology* 8:69-186.
- GROARK, KEVIN P. 1996. Ritual and Therapeutic Use of "Hallucinogenic" Harvester Ants (*Pogonomyrmex*) in Native South-Central California. *Journal of Ethnobiology* 16(1):1-29.
- HARRINGTON, JOHN PEABODY. 1933. Chinigchinich (chi-ñi'ch-ñich): A Revised and Annotated Version of Alfred Robinson's Translation of the Belief, Usages, Customs and Extravagancies [sic.] of the Indians of this Mission of San Juan Capistrano called the Acagchemem Tribe (Edited by Phil Townshend Hanna, Annotations by John P. Harrington, Foreword by Frederick Webb Hodge, Illustrations by Jean Goodwin, Published by Thomas E. Williams). Santa Ana, California: Fine Arts Press, Santa Ana High School and Junior College. (Reprinted as facsimile edition in 1976 by Malki Museum Press [Morongo Indian Reservation, Banning, CA], with a new preface by William Bright).
- . 1934. A New Original Version of Boscana's Historical Account of the San Juan Capistrano Indians of Southern California (With Two Plates). *Smithsonian Miscellaneous Collections* 94(4):1-62.
- . 1986a. John P. Harrington Papers, Part 2 (Northern and Central California). Washington: Smithsonian Institution, National Anthropological Archives. [Microfilm edition. Kraus International Publications, Millwood, NY.].
- . 1986b. John P. Harrington Papers, Part 3 (Southern California/Basin). Washington: Smithsonian Institution, National Anthropological Archives. [Microfilm edition. Kraus International Publications, Millwood, NY.].
- HUDSON, TRAVIS (editor). 1979. *Breath of the Sun: Life in Early California as Told by a Chumash Indian, Fernando Librado, to John P. Harrington*. Malki Museum Press, Morongo Indian Reservation, Banning, CA.
- JOHNSTON, BERNICE EASTMAN. 1962. California's Gabrielino Indians. *Southwest Museum, Los Angeles*.
- KROEBER, ALFRED. 1925. *Handbook of the Indians of California*. Bureau of American Ethnology Bulletin 78. Washington D.C.
- OTT, JONATHAN. 1993. *Pharmacothoon: Entheogenic Drugs, Their Plant Sources and History*. Natural Products Co., Kennewick, WA.
- REICHLIN, HENRY and PAUL REICHLIN. 1971. *Le Manuscrit Boscana de la Bibliothèque Nationale de Paris: Relation sur les Indiens Acâgchemem de la Mission de San Juan Capistrano, Californie*. *Journal de la Société des Américanistes* LX: 233-273.
- REID, HUGO. 1968 [1852]. *The Indians of Los Angeles County: Hugo Reid's Letters of 1852* (edited and annotated by Robert F. Heizer). *Southwest Museum Papers* 21. Los Angeles: Southwest Museum.
- ROBINSON, ALFRED. 1846. *Life in California*. Wiley & Putnam, New York. [Boscana's text appears as an appendix, pp. 229-341].
- SAINT-HILAIRE, A.F.C.P. de. 1824. *Histoire du Plantes les plus Remarquables du Bresil et du Paraguay*. [Republished in 1946 by A. Jenkins (ed.) *Chronica Botanica* 10:24-61]
- SCHMIDT, JUSTIN O. and MURRAY S. BLUM. 1978a. A Harvester Ant Venom: Chemistry and Pharmacology. *Science* 200:1064-1066.
- . 1978b. Pharmacological and Toxicological Properties of Harvester Ant, *Pogonomyrmex badius*, Venom. *Toxicology* 16: 645-651.
- . 1978c. The Biochemical Constituents of the Venom of the Harvester Ant, *Pogonomyrmex badius*. *Comparative Biochemistry and Physiology* 61C: 239-247.
- SCHULTZ, D.R. and P.I. ARNOLD. 1978. Ant Venom (*Pseudomyrmex* sp.) as an activator of C1 and an inactivator of C3b Inactivator: Its Use in Rheumatoid Arthritis. Pp. 172-186 in *Clinical Aspects*

- of the Complement System (W. Opferkuch, K. Rother and D. R. Schultz, eds.). P.S.G. Publishers, Massachusetts.
- SPARKMAN, PHILIP S. 1908. The Culture of the Luiseño Indians. University of California Publications in American Archaeology and Ethnology 8:187-234.
- VOEGELIN, ERMINIE W. 1938. Tübatulabal Ethnography. University of California Anthropological Records 2:1-84.
- WALKER, PHILLIP L. and TRAVIS HUDSON. 1993. Chumash Healing: Changing Health and Medical Practices in an American Indian Society. Malki Museum Press, Morongo Indian Reservation, Banning, CA.
- WEIL, ANDREW T. and WADE DAVIS. 1994. *Bufo alvarius*: A Potent Hallucinogen of Animal Origin. *Journal of Ethnopharmacology* 41:1-8.
- WHITE, RAYMOND C. 1963. Luiseño Social Organization. University of California Publications in American Archaeology and Ethnology 48(2):1-194. University of California Press, Berkeley, CA.
- ZIGMOND, MAURICE. 1977. The Supernatural World of the Kawaiisu. Pp. 59-95 in *Flowers of the Wind: Papers on Ritual, Myth and Symbolism in California and the Southwest* (T. C. Blackburn, editor). Ballena Press, Socorro, NM.